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Conference Abstract

Managing *Ex Situ* Collections of Wild Species' Seeds: Use of Biodiversity Informatics in the Millennium Seed Bank to Address Challenges

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Abstract

The Royal Botanic Gardens Kew manages the Millennium Seed Bank (MSB) Partnership, the largest *ex situ* conservation program for wild plant species in the world. The long-term storage of viable dry seed collections ('orthodox' seeds) in deep-freeze chambers and maintaining their quality, viability and longevity for future use are central to the conservation effort. Seed collections conserved within the vault of MSB represent the highest concentration of living seed-plant biodiversity on earth with over 83,500 collections from 37,940 vascular plant species originating from nine bio-geographical areas, 189 countries and territories, 35 biodiversity hotspots, 357 families and 5821 genera.

Curation of living seeds from such diversity and wide geographic origin is challenging and requires breadth and depth of knowledge, resources and experience in taxonomy and seed biology, physiology, morphology and ecology in order to understand taxon level seed traits related to seed viability, germination and survival in long-term storage. We describe how biodiversity informatics are integrated with collection and trait data to develop decision and prediction tools to support curators and collection professionals at MSB to address challenges in decision making during curatorial activities to best allocate their conservation effort. Bringing these disciplines together and bridging the gaps require accurate data acquisition, sharing, analysis and interoperability. MSB met these challenges through

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collaboration and establishing and sharing data standards, structures, algorithms and resources with MSB Partnership, currently across 95 countries.

A range of databases and tools are central to carrying out the daily routine work of curators at MSB. (1) The Seed Bank Database (SBD) captures collection level data from the point of sampling and throughout their lifespan in storage. It is the main data hub used to manage collections. SBD includes mathematical and statistical computations to monitor quality, quantity and viability of collections. (2) The Taxon Database (TDB) consolidates the plant name backbone with taxonomic identities of collections. It enables curators to identify the taxon to allocate the correct curation protocol for conservation. (3) The Seed Information Database (SID) serves as a main source of a variety of taxon-based biological information for use in large scale analysis and decision support. It is a compilation of seed biological trait data (weights, storage behavior, germination, viability constant, protein content, oil content, morphology, dispersal) from MSB Partnership collections and other published and unpublished sources. SID, which is in public domain (http://data.kew.org/sid/), also provides useful tools that incorporate mathematical models to predict viability of seeds after period of storage in range of environments. SID data are used at MSB to predict seed storage behavior and to identify short-lived taxa in long-term storage. (4) The Data Analysis and Reporting Tool (DART) serves as the user interface where SBD, TDB, SID and other Kew databases can be linked. It is the main tool used for data querying, analysis, and visualization. (5) The Germination Predictor Tool uses MSB Collection data (month of seed dispersal, geo-coordinates and seed germination) and world climatic data (precipitation and temperature) to predict conditions and treatments that are required to germinate seeds based on taxonomy and geographic origin of collections. This enables curators to simulate conditions that trigger germination of seeds in their natural environment. Kew's UK Germination toolbox, which is in the public domain (http://data.kew.org/ukgerm/search), mostly uses SBD germination data and provides successful germination conditions for UK native species. (6) The Species Prioritization Tool ranks vascular plant taxa by using an integrative assessment technique that incorporates taxon level data compiled from several Kew and open databases to yield priority scores based on multiple priority-setting criteria. It is used by collection managers during collection acquisition and management to identify conservation priority taxa and collections.

The above examples of applications used at the MSB show clearly how biodiversity data provides essential systems for collection management in *ex situ* conservation.

Keywords

Millennium Seed Bank, Seeds, Collections, Curation, Biodiversity Informatics, Tools

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